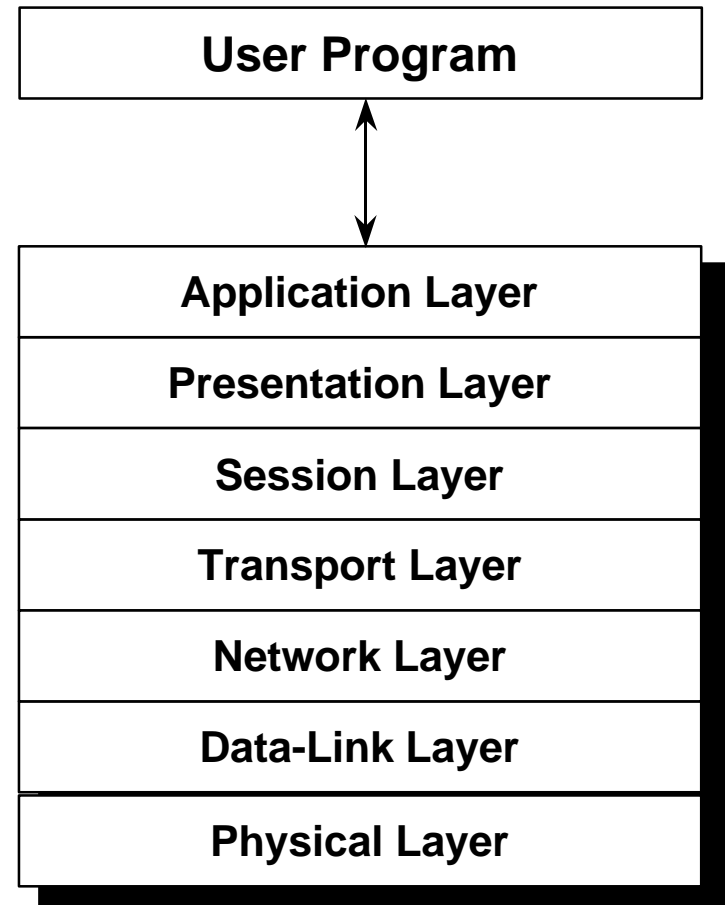# *Messaging Services*

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Agenda

➢ What is a messaging service?

➢ Messaging services in automation

➢ Common functions

➢ Some specifics & developments

➢ Potential applications

➢ Areas at issues

➢ Benefits

Where does messaging fit?

➢ In the OSI Reference Model, Messaging is an application layer function.

User Program

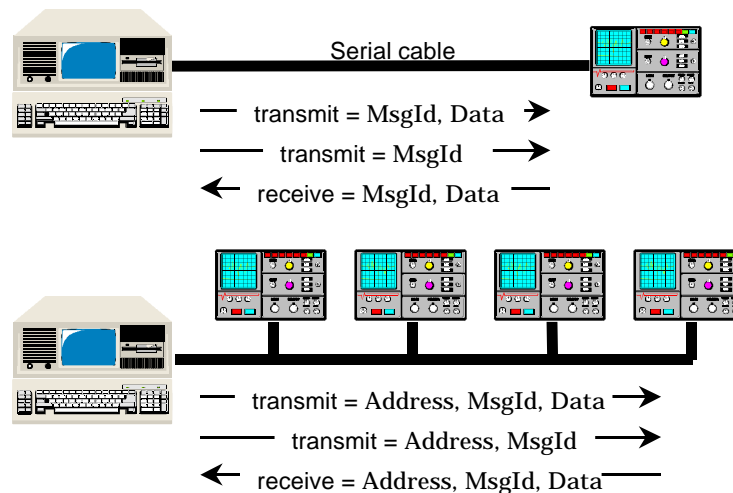| Application Layer |
|---|
| Presentation Layer |
| Session Layer |
| Transport Layer |
| Network Layer |
| Data-Link Layer |
| Physical Layer |

What is a messaging service?

➢ Any set of services that support the exchange of data between two (or more) systems or devices

  ➢ Define message types

  ➢ Define message structure

  ➢ Define procedures

  ➢ Define the roles of participates, for example:

    ➢ master - slave

    ➢ client - server

    ➢ publish - subscribe

    Who initiates communications, responses, error handling, priority, etc.
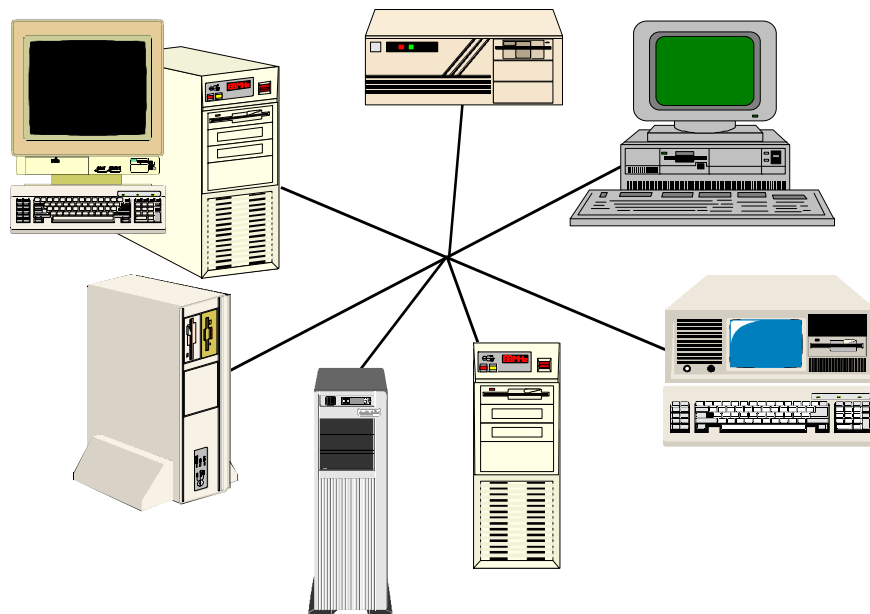
A Simple Message Service

➢ Simple messaging services provide transmit & receive operations using an message identifier

➢ Handshaking and error detection are performed by the applications or by the data-link / physical layers

➢ Some messaging services implement addition data integrity functions (checksum, CRC)

➢ Some messaging services provide addressing to support communication with multiple devices

Serial cable

transmit = MsgId, Data
transmit = MsgId
receive = MsgId, Data

transmit = Address, MsgId, Data
transmit = Address, MsgId
receive = Address, MsgId, Data

Limited number of devices
Limited set of operations
Limited number of messages
Limited data sets

A Sophisticated Message Service

➢ A large range of operations (many message types)

➢ A sophisticated message structure

➢ A sophisticated dialog

➢ Services for data integrity and data security

➢ Addressing for large systems

Large number of devices
Large set of operations
Large number of messages
Large data sets

Comparison of Messages

➢ **Simple messaging services provide:**

  ➢ Address
  ➢ Msg Id
  ➢ Data
  ➢ Checksum

Example, set or get a variable from a device.

Write data to the device

Addr	MsgId	Data	Checksum
8 bits	8 bits	32 bits	16 bits

Request data from the device

Addr	MsgId	Checksum
8 bits	8 bits	16 bits

Data response from the device

Addr	MsgId	Data	Checksum
8 bits	8 bits	32 bits	16 bits

➢ **Sophisticated messaging services like MMS provide services and a message structure that can support a diverse range of functionality**

Example, set or get a variable from a device.

Write data to the device

MMS	Write	Description

Where "Description" provides for the symbolic named or physical address of the requested variable. The requested variable could be a simple integer or a complex data structure.

Request data from the device

MMS	Read	Description

Where "Description" provides for the symbolic named, physical address of the requested variable or a list of variables.

Data response from the device

MMS	Read_rsp	Data

The response will include sufficient information to identify the data contained in the response.

Messaging in Automation

➢ Modbus, Modbus+ *(Proprietary, layers 1, 2 & 7)*

➢ Allen-Bradley Data Highway *(Proprietary, layers 1, 2 & 7)*

➢ GeniusNet (GE-Fanuc) *(Proprietary, layers 1, 2 & 7)*

➢ LonWorks (Echelon)
   (Proprietary, layers 1 thru 6, Layer 1 & 2 moving toward std)

➢ Distribution Line Messaging Specification (DLMS)
   (European Std, layers 1, 2 & 7*)

➢ Profibus *(German Std, layers 1, 2 & 7- FMS*)*

➢ Fieldbus Foundation *(US Std, layers 1, 2 & 7 - FMS*)*

➢ WorldFIP *(French Std, layers 1,2 & 7)*

➢ Manufacturing Message Specification
   (Intl Std, layer 7, operates over std stacks)

➢ Common Management Information Service
   (Intl. Std, layer 7, operates over std stacks)

➢ Simple Network Management Protocol
   (Internet Std, layer 7, operates over IP)

Proprietary solutions of manufacturing and industrial applications No transport or network layers

Initially a proprietary solution, promoters are now seeking adoption by standards bodies.

Standard for electric utility device operation. No transport or network layers.
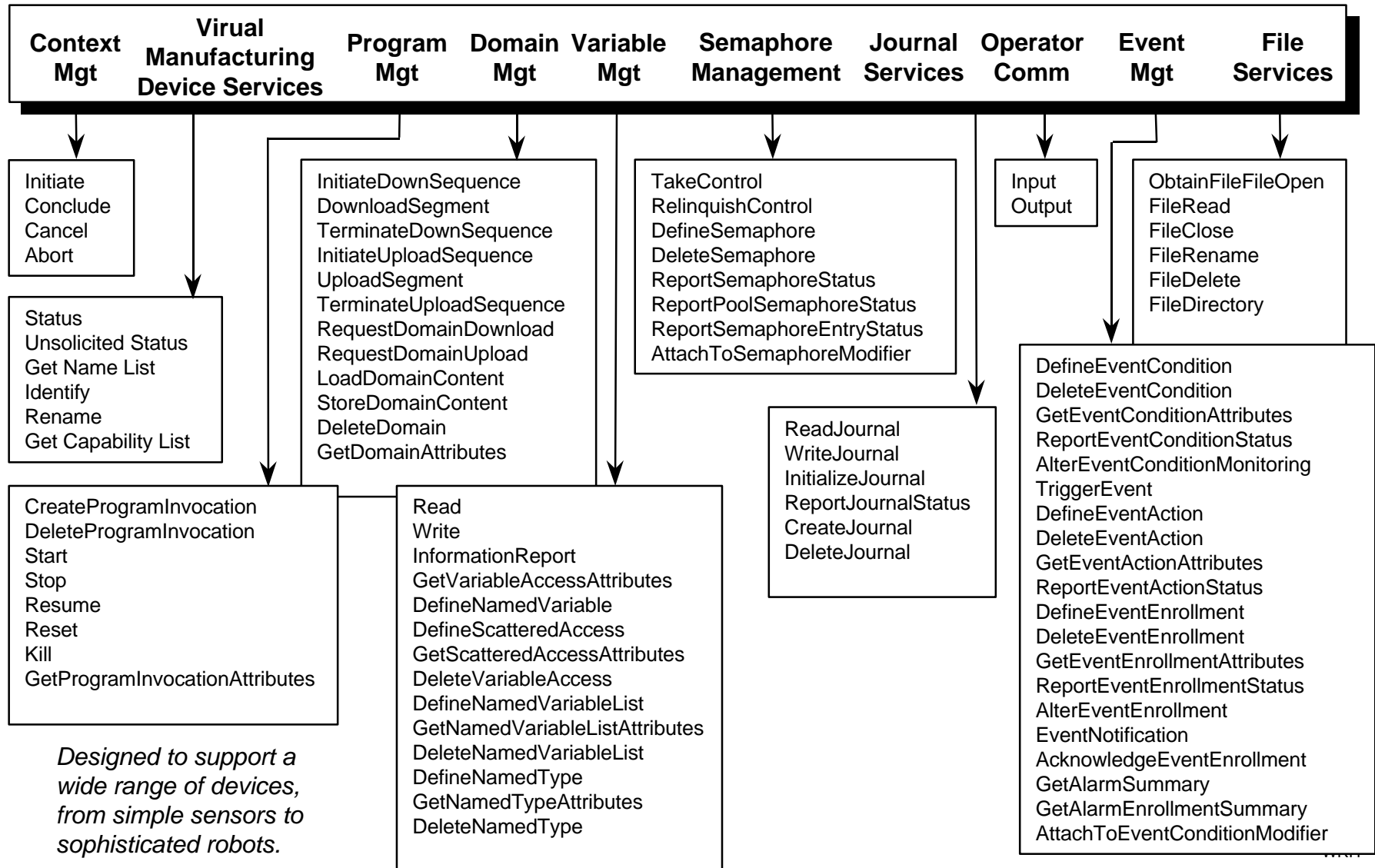
Designed for tight process control applications, token based with limited data bus speeds
No transport or network layers

Designed for full 7 layer protocol implementations, operate over most standard transport, network, data-link and physical layers.

* based on Manufacturing Message Specification

MMS Services

MMS provides 87 services to manage devices

Context Mgt	Virtual Manufacturing Device Services	Program Mgt	Domain Mgt	Variable Mgt	Semaphore Management	Journal Services	Operator Comm	Event Mgt	File Services

Initiate
Conclude
Cancel
Abort

Status
Unsolicited Status
Get Name List
Identify
Rename
Get Capability List

CreateProgramInvocation
DeleteProgramInvocation
Start
Stop
Resume
Reset
Kill
GetProgramInvocationAttributes

Designed to support a wide range of devices, from simple sensors to sophisticated robots.

InitiateDownSequence
DownloadSegment
TerminateDownSequence
InitiateUploadSequence
UploadSegment
TerminateUploadSequence
RequestDomainDownload
RequestDomainUpload
LoadDomainContent
StoreDomainContent
DeleteDomain
GetDomainAttributes

Read
Write
InformationReport
GetVariableAccessAttributes
DefineNamedVariable
DefineScatteredAccess
GetScatteredAccessAttributes
DeleteVariableAccess
DefineNamedVariableList
GetNamedVariableListAttributes
DeleteNamedVariableList
DefineNamedType
GetNamedTypeAttributes
DeleteNamedType

TakeControl
RelinquishControl
DefineSemaphore
DeleteSemaphore
ReportSemaphoreStatus
ReportPoolSemaphoreStatus
ReportSemaphoreEntryStatus
AttachToSemaphoreModifier

ReadJournal
WriteJournal
InitializeJournal
ReportJournalStatus
CreateJournal
DeleteJournal

Input
Output

ObtainFileFileOpen
FileRead
FileClose
FileRename
FileDelete
FileDirectory

DefineEventCondition
DeleteEventCondition
GetEventConditionAttributes
ReportEventConditionStatus
AlterEventConditionMonitoring
TriggerEvent
DefineEventAction
DeleteEventAction
GetEventActionAttributes
ReportEventActionStatus
DefineEventEnrollment
DeleteEventEnrollment
GetEventEnrollmentAttributes
ReportEventEnrollmentStatus
AlterEventEnrollment
EventNotification
AcknowledgeEventEnrollment
GetAlarmSummary
GetAlarmEnrollmentSummary
AttachToEventConditionModifier

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FMS Services

FMS provides a subset of MMS services to manage devices

Context Mgt	Virual Field Device Services	Object Dictionary	Program Mgt	Variable Mgt	Domain Mgt	Event Mgt

Context Mgt
Initiate
Abort
Reject

Virual Field Device Services
Status
Unsolicited Status
Identify

Object Dictionary
Get Object Dictionary (short form)
Get Object Dictionary (long form)
Initiate Put Object Dictionary
Put Object Dictionary
Terminate Put Object Dictionary

Program Mgt
Create Program Invocation
Delete Program Invocation
Start
Stop
Kill
Resume
Reset
Kill

Variable Mgt
Read
Write
Read with Type
Write with Type
PhysRead
PhysWrite
Information Report
Information Report with Type
Define Variable List
Delete Variable List

Domain Mgt
Initiate Download Sequence
Download Segment
Terminate Download Sequence
Initiate Upload Sequence
Upload Segment
Terminate Upload Sequence
Request Domain Upload

Event Mgt
Event Notification
Event Notification with Type
Acknowledge Event Notification
Alter Event Condition Monitoring

The Fieldbus Message Specification built on the services in MMS adding the Object Dictionary. Focused on simpler devices, FMS does not support services for: semaphores, journals, files or operator communications.

Common Features

➢ The basic functions in messaging services for automation are provided by all solutions:

  ➢ SNMP, CMIS/CMIP, MMS, FMS, DLMS

    ➢ *Write (Set), Read (Get), Report*

➢ Application layer standards like the Fieldbus Message Specification (FMS for Profibus and Fieldbus Foundation) and Distributed Line Messaging Specification (DLMS) are derived from MMS

➢ Basing the Space Messaging Service on MMS is clearly the right thing to do.

Developments

➢ MMS re-balloted in 1996 and approved

➢ Inter-Control Center Protocol (ICCP) has been adopted as a Draft International Standard (based on MMS)

➢ TASE.2 is moving toward International Standard through the IEC (based on MMS)

➢ IEEE, Power Engineering Society taking over automation standards effort initiated by EPRI under the Utility Communications Architecture (UCA)

➢ Slow but continued expansion in manufacturing sector

➢ Expanding use in China, India, and the far east

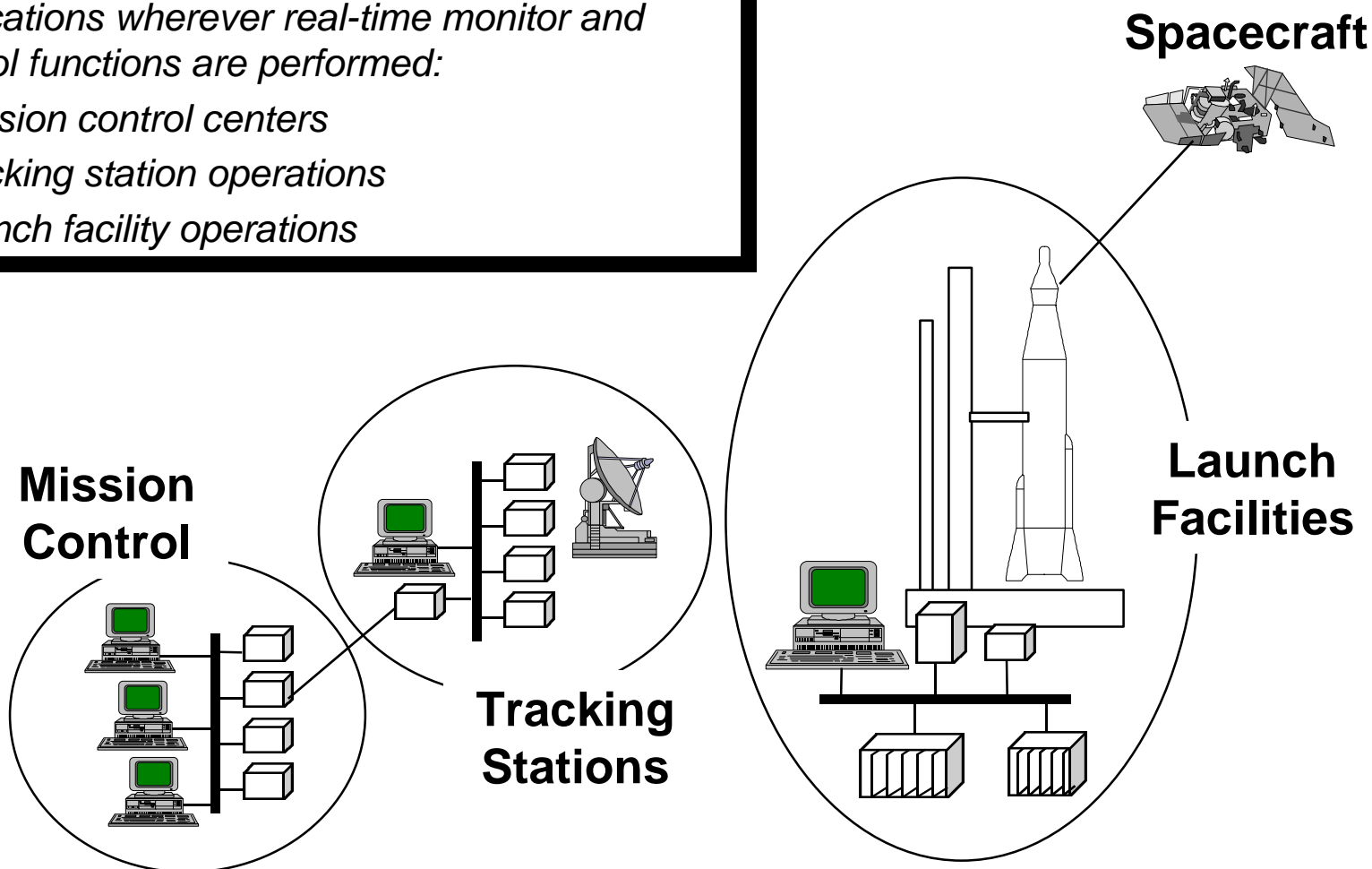➢ US Post Office initiating integration of facilities (cells based on Profibus)

Functionality Enhancements

➢ In UCA, control blocks have been developed to enhance inter-operability

➢ Products incorporating X.500 address services

➢ Security elements implemented at the ACSE level to support multi-level access to sensitive data

➢ Products for embedded systems available for constrained devices (64K code, 8 bit processors)

➢ ITU Draft Proposal for the FastByte implemented, applied and a available

➢ High performance stacks now operating at the cutting edge of available technologies
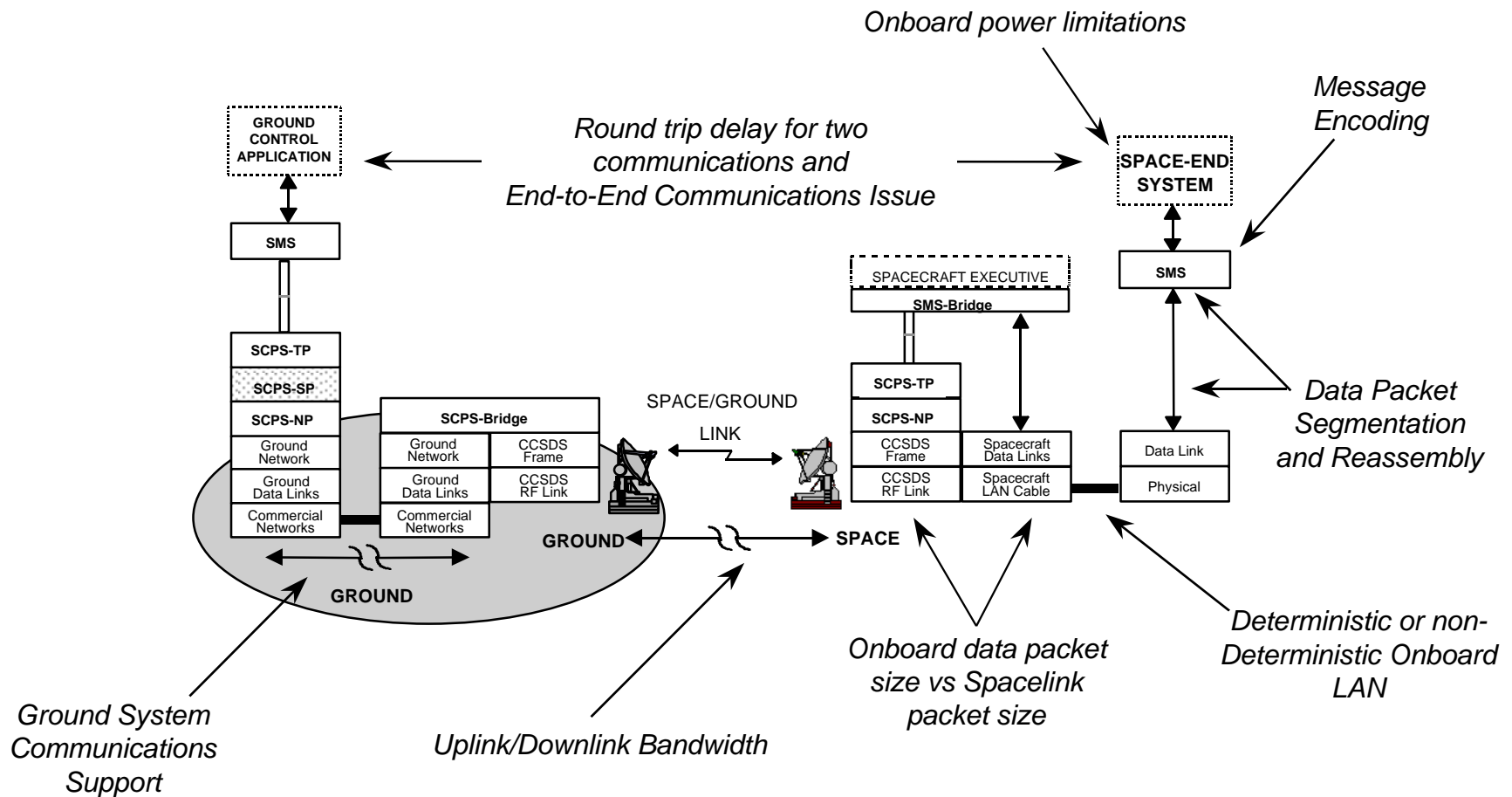
Potential applications

A standard message service has potential applications wherever real-time monitor and control functions are performed:

- Mission control centers
- Tracking station operations
- Launch facility operations

Spacecraft

Mission Control

Tracking Stations

Launch Facilities

Areas at Issue

The solutions must deal with the entire system

Onboard power limitations

Message Encoding

GROUND CONTROL APPLICATION

Round trip delay for two communications and End-to-End Communications Issue

SPACE-END SYSTEM

SMS

SCPS-TP
SCPS-SP
SCPS-NP
Ground Network
Ground Data Links
Commercial Networks

SCPS-Bridge
Ground Network | CCSDS Frame
Ground Data Links | CCSDS RF Link
Commercial Networks

SPACE/GROUND LINK

SPACECRAFT EXECUTIVE
SMS-Bridge
SCPS-TP
SCPS-NP
CCSDS Frame | Spacecraft Data Links
CCSDS RF Link | Spacecraft LAN Cable

SMS
Data Link
Physical

Data Packet Segmentation and Reassembly

GROUND

GROUND ← → SPACE

Ground System Communications Support

Uplink/Downlink Bandwidth

Onboard data packet size vs Spacelink packet size

Deterministic or non-Deterministic Onboard LAN

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Benefits

➢ A standard provide industry with a clearly define interface to products that can inter-operate with products from other vendors.

➢ Standards with reduce the cost of re-inventing the messaging system for every new mission.

➢ A standards with promote commercial competition for business and reduce costs.

Man will go to any expediency to avoid the real labor of thinking